



UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/828,473	04/09/2001	Kwang-bok Lee	249/253	6762

27849 7590 07/09/2004

LEE & STERBA, P.C.
1101 WILSON BOULEVARD
SUITE 2000
ARLINGTON, VA 22209

EXAMINER

AHN, SAM K

ART UNIT	PAPER NUMBER
----------	--------------

2634

DATE MAILED: 07/09/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/828,473

Applicant(s)

LEE ET AL.

Examiner

Sam K. Ahn

Art Unit

2634

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 09 April 2001.
2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-20 is/are pending in the application.
4a) Of the above claim(s) _____ is/are withdrawn from consideration.
5) ☐ Claim(s) _____ is/are allowed.
6) ☒ Claim(s) 1-20 is/are rejected.
7) ☐ Claim(s) _____ is/are objected to.
8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
10) ☒ The drawing(s) filed on 09 April 2001 is/are: a) ☐ accepted or b) ☒ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
a) ☒ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date 5.6.
4) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Priority

1. Acknowledgment is made of applicant's claim for foreign priority under 35 U.S.C. 119(a)-(d). The certified copy has been filed in parent Application No. 4, filed on 7/19/01.

Drawings

2. The drawings are objected to under 37 CFR 1.83(a). The drawings must show every feature of the invention specified in the claims. Therefore, the "storing the base vectors and quantizing coefficients in the transmitter", as claimed in claim 13, must be shown or the feature(s) canceled from the claim(s). No new matter should be entered.

Corrected drawing sheets are required in reply to the Office action to avoid abandonment of the application. Any amended replacement drawing sheet should include all of the figures appearing on the immediate prior version of the sheet, even if only one figure is being amended. The figure or figure number of an amended drawing should not be labeled as "amended." If a drawing figure is to be canceled, the appropriate figure must be removed from the replacement sheet, and where necessary, the remaining figures must be renumbered and appropriate changes made to the brief description of the several views of the drawings for consistency. Additional replacement sheets may be necessary to show the renumbering of the remaining figures. The replacement sheet(s) should be labeled "Replacement Sheet" in the page header (as per 37 CFR 1.84(c)) so as not to obstruct any portion

of the drawing figures. If the changes are not accepted by the examiner, the applicant will be notified and informed of any required corrective action in the next Office action. The objection to the drawings will not be held in abeyance.

Claim Objections

3. Claims 1-20 are objected to because of the following informalities:

In claims 1, 6, 9 and 14, lines 4, 4, 2-3 and 2-3, respectively, delete "feedback information" and insert "a feedback information".

In claims 1, 5, 6, 7 and 12, lines 11, 3, 14, 10-11 and 5, respectively, delete "feedback information" and insert "the feedback information".

In claims 2, 6, 7 and 9, lines 4, 14, 4 and 8, respectively, delete "the channel state" and insert "a channel state".

In claims 3, 4 and 8, lines 5, 2 and 5, respectively, delete "the objective function" and insert "the predetermined objective function".

In claim 5, line 5, delete "an information signal" and insert "the information signal".

In claim 7, line 5, delete "a number" and insert "the number".

In claim 7, line 8, delete "a plurality" and insert "the plurality".

In claim 7, line 9, delete "a weight that maximizes a predetermined" and insert "the weight that maximizes the predetermined".

In claim 8, lines 1-2, delete "an objective function" and insert "the predetermined objective function".

In claims 9 and 14, lines 3 and 3, respectively, delete "the received signals" and insert "received signals".

In claim 10, line 2, delete "an objective function" and insert "a predetermined objective function".

In claim 11, lines 2 and 6, delete "basis vectors" and insert "the basis vectors".

In claim 11, line 3, delete "coefficients" and insert "the coefficients".

In claim 11, lines 6-7, delete "the selected coefficients" and insert "the selected S coefficients".

In claims 12, 13, 17 and 18, lines 1, 1, 1 and 1, respectively, delete "if" and insert "when the".

In claim 12, lines 2, 3 and 6, delete "quantization" and insert "quantizing".

In claim 13, lines 3, 4, 7 and 8, delete "quantization" and insert "quantizing".

In claim 13, lines 3 and 7, delete "base vectors" and insert "basis vectors".

In claim 14, line 8, delete "vectors where" and insert "vectors, where".

In claims 14 and 16, lines 13 and 1, respectively, delete "if" and insert "when".

In claims 15, 19 and 20, lines 1, 5 and 2, respectively, delete "the objective function" and insert "the predetermined objective function".

In claim 17, line 3, delete "a received" and insert "the received".

In claim 17, line 4, delete "an information signal" and insert "the information signal".

In claim 19, line 4, delete "the feedback information approximation unit" and insert "the feedback information restoring unit".

Appropriate correction is required.

Claim Rejections - 35 USC § 112

The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

4. Claims 1-20 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

In claims 1, 3, 19, lines 11, 5, 5, respectively, recite "lower-dimensional" or "lower dimension". It is unclear and indefinite as to what is meant by a lower-dimensional one in the claim.

In claims 1 and 6, lines 12 and 15, respectively, recites "a radio frequency signal". In lines 6 and 6, respectively, also recites "a radio frequency signal". Therefore, it is unclear and indefinite as to whether the receiver modifies the radio frequency signal after reception, or attempts to maintain the radio frequency signal to be equivalent to the radio frequency signal being transmitted to the transmitter.

In claims 9 and 14, lines 2-3 and 2-3, respectively, recite "a feedback information" and in line 3, recites "the feedback information". It appears that the feedback information received from the transmitter is transmitted back to the transmitter by the receiver without any changes made. Is this correct?

In claim 9, lines 10 and 11-12, recites "the approximated dimension" and "the approximated dimension, or indices". There is no antecedent basis for the claim. Furthermore, it is unclear and indefinite as to what is meant by "the approximated dimension or indices".

In claim 11, lines 3-4, recites "the inner product". It is unclear and indefinite as to what is meant by the limitation.

In claim 16, lines 2 and 4, recite $M C_s$ and N^s . It is unclear and indefinite as it does not further provide explanation of these cases.

Regarding claims 17 and 18, it appears that claim 14 recites limitations performed by the receiver, and limitations of claims 17 and 18 are performed by the transmitter, however, claims 17 and 18 does not further recite which device is performing the task, which renders the claim to be unclear and indefinite.

Claims 2, 4, 5, 7, 8, 10, 13, 15, 18 and 20 directly or indirectly depend on claim 1, 6, 9 or 14.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

5. Claims 1, 2, 5-7, 9, 12-14, 17, 18 and 20 are rejected under 35 U.S.C. 103(a) as being unpatentable over Wallace et al. (Wallace) in view of Martin et al. (Martin).

Regarding claims 1 and 6, Wallace teaches a wireless communication system (see Fig.1A) including a plurality of transmitting antennas (116A~116T) and a plurality of receiving antennas (122A~122R) through which signals are transmitted and received, the wireless communication system comprising: a transmitter (see Fig.3) that restores a feedback information (from CSI) from a predetermined feedback signal (CSI), weights (vectors and coefficients) an information signal (output of 332A~332K) with the restored feedback information, and converts the weighted information signal to a radio frequency signal (output of 116A~116T) in order to transmit the radio frequency signal. (note col.19, line 20 – col.21, line 44)

Wallace further teaches a receiver (see Fig.6) that receives the radio frequency signal to estimate the state of a channel through which the radio frequency signal is transmitted, calculates a weight of a dimensionally corresponding to the number of transmitting antennas (note equation 2, approximates the weight as lower dimensional one to extract the feedback information. (note col.24, line 25 – col.27, line 33)

However, Wallace does not explicitly disclose converting the feedback information into a radio frequency signal to send the radio frequency signal to the transmitter, while only showing a feedback signal (CSI).

Martin teaches in the same field of endeavor, transmitting a feedback signal back to the transmitter (see 102' in Fig.3). Martin explicitly teaches wherein the feedback signal is transmitted through the airwave, which means that the

feedback signal is converted into a radio frequency signal. (note col.3, line 48 – col.4, line 65) A feedback signal is converted to a radio frequency signal for the purpose of increasing transmission range. Therefore, it would have been obvious to one skilled in the art at the time of the invention to analyze that the CSI signal taught by Wallace would not be able to be received by the unit (110 in Fig.1) if the CSI signal were not converted to a radio frequency signal.

Regarding claims 2 and 7, Wallace in view of Martin teach all subject matter claimed, as applied to claim 1 or 6. Wallace further teaches wherein the receiver comprises a baseband processor(612, 614 and 620 in Fig.6) that extracts a baseband signal from the radio frequency signal and estimates the channel state, a feedback information approximation unit (148 in Fig.1B) that calculates the weight of a dimensionality corresponding to the number of the transmitting antennas (note col.9, lines 28-48), which maximizes a predetermined objective function (maximum system capacity, note col.27, lines 13-25), and approximates the weight as lower-dimensional one to extract the feedback information, and a feedback unit (149 in Fig.1B) that sends the feedback information back to the transmitter.

Regarding claims 5, 12 and 17, Wallace in view of Martin teach all subject matter claimed, as applied to claim 1, 9 or 14. Wallace further teaches a baseband processor that encodes and modulates the information signal (312 and 332), as

weighting unit (334) that multiplies the restored feedback information (CSI) by an output signal of the baseband processor, and a radio frequency processor (114) that converts an output signal of the weighting unit to a radio frequency signal to output the radio frequency signal. However, Wallace does not explicitly teach a feedback information restoring unit that restores the feedback information from the radio frequency signal received from the receiver. Martin teaches this limitation in 150 in Fig.3. Therefore, one skilled in the art would, again, analyze that the CSI signal received by the transmitter would have the feedback information restoring unit converting the radio frequency signal received to the feedback signal for the purpose of detecting and implementing as weight, since the radio frequency signal needs further processing to be properly detected and implemented as the feedback information.

Regarding claims 9 and 14, Wallace in view of Martin teach all subject matter claimed, as explained above. Wallace further teaches wherein the approximating the weight as dimension S which is less than M and quantizing coefficients for the approximated dimension. (note col.18, lines 5-32 where subset of channel are selected to reduce the amount of feedback information)

Regarding claims 13 and 18, Wallace in view of Martin teach all subject matter claimed, as applied to claim 9 or 14. Wallace further teaches all limitation claimed in regards to claim 12. Although, Wallace nor Martin explicitly teach

wherein the weight received through the feedback signal is stored in the transmitter, it would have been obvious to one skilled in the art. A transmitter may have a memory that stores different data for the purpose of retrieving information efficiently. Therefore, when the previously received feedback information is equivalent to the newly received feedback information, the transmitter may be able to use the already stored feedback information from the memory for the purpose of increasing processing speed as the transmitter need not require further processing to convert the received feedback information as weights to precondition the future information signal.

Regarding claim 20, Wallace in view of Martin teach all subject matter claimed, as applied to claim 14. Wallace further teaches wherein Wopt is an eigenvector corresponding to a maximum eigenvalue in the predetermined objective function. (note col.9, lines 28-48 and col.13, line 22 - col.14, line 30)

6. Claims 3, 4, 8, 10, 15 and 19 are rejected under 35 U.S.C. 103(a) as being unpatentable over Wallace et al. (Wallace) in view of Martin et al. (Martin) and 3GPP (IDS, paper no.5).

Regarding claims 3, 8, 10, 15 and 19, Wallace in view of Martin teach all subject matter claimed, as applied to claim 1, 6, 9 or 14. However, Wallace and Martin do not teach wherein the weights meet a predetermined function of $P=W^H H^H H W$. 3GPP teaches this limitation. (note section 8.1 Determination of feedback

information) Therefore, it would have been obvious to one skilled in the art at the time of the invention to compute the weights to meet the predetermined function, which is a well-known standard in the art for the purpose of meeting the specification of the standard.

Regarding claim 4, Wallace in view of Martin and 3GPP teach all subject matter claimed, as applied to claim 1. Wallace further teaches wherein Wopt is an eigenvector corresponding to a maximum eigenvalue in the predetermined objective function. (note col.9, lines 28-48 and col.13, line 22 - col.14, line 30)

Allowable Subject Matter

7. Claim 11 and 16 would be allowable if rewritten to overcome the rejection(s) under 35 U.S.C. 112, second paragraph, and claim objections, set forth in this Office action and to include all of the limitations of the base claim and any intervening claims.
8. The following is a statement of reasons for the indication of allowable subject matter:
Present application discloses a wireless system comprising multiple antennas in the transmitter and receiver. The receiver receives a information signal and determines the condition of the channel by analyzing the information signal received. The receiver computes the information signal through weights having a predetermined function of $P=W^H H^H H W$, wherein W is the weight, H is the condition of the channel and superscript H is the Hermitian operator. The weights calculated is fed back to

the transmitter wherein the transmitter uses the weights to precondition the future transmission. And, applicants teach wherein the coefficients are calculated through W_{opt} and each basis vector. And furthermore, applicants teach a condition wherein the predetermined function is not met, and performing steps of repeating in different cases where vectors and coefficients are selected for weight computation. Closest prior arts, Wallace and Martin, teach all subject matter claimed. However, Wallace nor Martin, solely or in combination, do not teach when the predetermined function is not met, performing steps of repeating in different cases where vectors and coefficients are selected for weight computation. And also, prior art do not teach from the predetermined function of $P=W^H H^H H W$, coefficients are calculated from W_{opt} and each basis vector and selectively choosing coefficients and vectors.

Conclusion

9. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

Tangemann teaches wherein number of matrix vectors are determined by the number of antennas.

Dabak et al. teach in the same field of endeavor, applying open and closed loop diversity.

Harrison teaches adaptive antenna array calculating weights from a pilot signal.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to **Sam Ahn** whose telephone number is **(703) 305-0754**.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, **Stephen Chin**, can be reached at **(703) 305-4714**.

Any response to this action should be mailed to:

Commissioner of Patents and Trademarks

P.O. Box 1450

Alexandria, VA 22313-1450

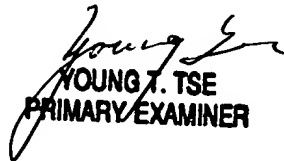
or faxed to:

(703) 872-9306

Hand-delivered responses should be brought to Crystal Park II, 2121 Crystal Drive, Arlington, VA., Sixth Floor (Receptionist).

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the Technology Center 2600 Customer Service Office whose telephone number is (703) 306-0377.

Sam K. Ahn
6/22/04


YOUNG T. TSE
PRIMARY EXAMINER